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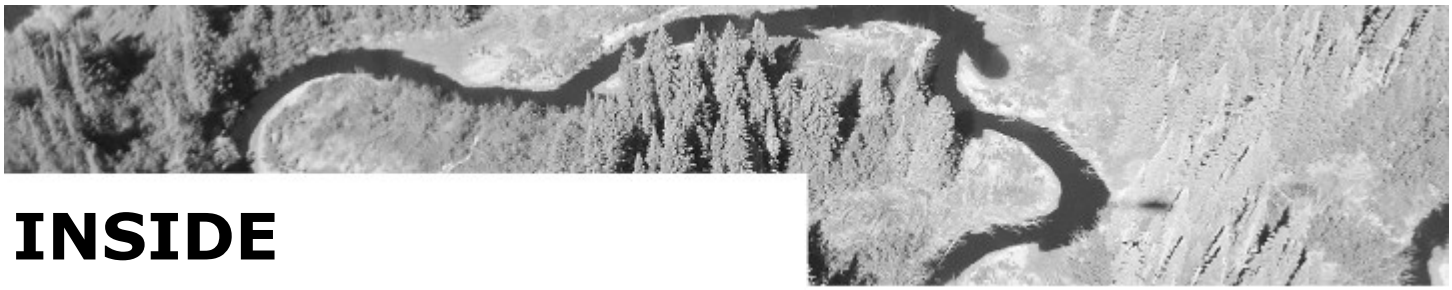
Remote sensing, inventory and regeneration

ALSO INSIDE



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THIS ISSUE

EVERY ISSUE

The Professional Forester is published quarterly by and for members of the Association, as well as those interested in the profession of forestry in Ontario.

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Forests of the future: Integrating climate change adaptation into plantation management

Lyndsay Cartwright, Toronto and Region Conservation Authority, edited for the OPFA Newsletter by **Sionaid Eggett**, Ontario Woodlot Association

Over the past decade, forests of southern Ontario including the Toronto region, have faced a variety of stressors. Pests, such as emerald ash borer and spongy moth, have caused tree death, decline, or a loss of crown vigour. Extreme weather events, such as the December 2013 ice storm and the 2022 derecho, have led to blow downs and tree mortality. Climate change is expected to fuel more of these extreme weather events along with the spread of novel insect pests and pathogens due to longer growing seasons. In addition, we can also expect to see warmer temperatures, more extreme heat days, fewer extreme cold days, and increased precipitation, though drier conditions remain a possibility.

These climate induced changes are expected to alter forest composition, structure, and function. Long-term monitoring programs are already finding more open forest canopies, which in turn have stimulated regeneration and ground vegetation, including the spread of invasive species. In the future, we expect that habitat will become less suitable for species at the southern extent of their range and more suitable for southern species. Changes in forest composition due to changing recruitment are also likely over the coming years as seedlings are more sensitive to changes in moisture and temperature. While forest productivity is expected to increase, additional stressors, such as the frequency and severity of disturbances, like drought, damaging winds, and ice storms, may limit this benefit.[1]

Forests perform a variety of processes, functions, and services essential for their existence, for wildlife, and for human well-being. These functions include temperature regulation, air quality regulation, water and nutrient cycling, wildlife habitat, carbon storage and sequestration, soil stability, and recreation and culture. These, along with many others, are the processes, functions, and services we want to continue even with the anticipated changes in climate.

Understanding these changes and the challenges they pose for forests, Toronto and Region Conservation Authority (TRCA) and its collaborators are developing management practices that best allow pine plantations to adapt to future changes in climate.

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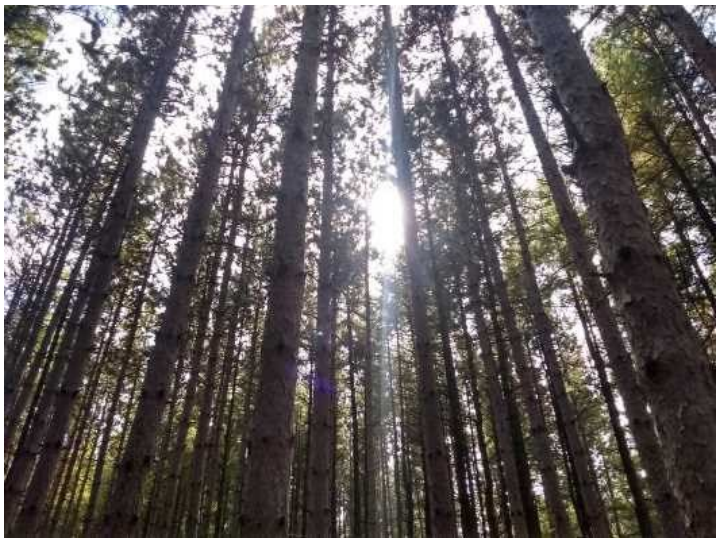

Participants tour conifer plantations in preparation for the workshop and development of climate-adapted prescriptions.

[1] Janowiak et al. 2018. New England and Northern New York Forest Ecosystem Vulnerability Assessment and Synthesis: A Report from the New England Climate Change Response Framework Project. United States Department of Agriculture, United States Forest Service. 234 pp. https://www.fs.usda.gov/research/treesearch/55635

(Continued from page 3)

This research will uncover how to best increase the resilience of forests through management as discussed in the December 2021 issue of *The Ontario Woodlander – Managing Our Woodlots for Climate Change*.[2]

Here we plan to conduct a climate change adaptation experiment like those used by the Adaptative Silviculture for Climate Change Network (ASCC)[2], a program seeking to synthesize outcomes of climate change adaptation science in forests across Canada and the United States. The ASCC network uses standardized methods across its sites, considering both the development of experimental treatments through a co-development workshop process and the subsequent implementation of treatments and monitoring.[3] Each study site within the network explores locally relevant climate change adaptation options within three broad treatment categories: resistance, resilience, and transition, along with a 'do nothing' control. These treatments provide a spectrum of climate change adaptation options, ranging from no action to intense intervention, providing forest managers with valuable insights into the best management practices for sustaining functional forests.

In October 2023, in collaboration with the Ontario Woodlot Association and the Northern Institute of Applied Climate Science, TRCA held a 3-day workshop. The purpose was to inform the experimental design of a climate change adaptation study for plantation management in the Toronto region. The workshop successfully brought together experts in climate science, forestry, forest ecology and management, among many other fields, representing organizations such as TRCA, Natural Resources Canada, Credit Valley Conservation, University of Waterloo, McMaster University, the Forest Gene Conservation Association, and Toronto Field Naturalists.

The workshop had three main goals: 1) engage local managers and scientists in the ASCC co-development framework through the co-creation of local climate change adaptation strategies, 2) introduce natural resource managers to conceptual tools and approaches that help integrate climate change into on-the-ground planning and decision-making processes, and 3) use the adaptive planning process to design specific climate change adaptation experimental treatments for plantations in the Toronto region.

The Ontario Woodlot Association also recognizes the need for landowners and forest practitioners to have access to tools and resources to mitigate against projected climate induced changes specific to their region in Ontario. This is precisely why the OWA partnered with the Climate Risk Institute to develop an upcoming course: *Forest Climate Resilience: A Practical Course for Landowners and Practitioners*. This instructional course focuses on assessing and adapting woodlot management to projected climate change scenarios and their impacts on woodlots. Not only is this course a first for the OWA, but it is the first of its kind in Ontario and Canada. The idea and core content for this course are based on the Northern Institute of Applied Climate Science (NIACS) program. Through collaboration and funding, we were able to bring this concept across the border and develop content and tools specifically for projected climate change impacts in Ontario, and relevant management adaptations for regions across the province. Check out the OWA website for further information and upcoming registration at ontariowoodlot.com.

[2] The Ontario Woodlander. 2021. Managing Our Woodlots for Climate Change. See the Adapting Forests to Climate Change page 24 for more detail about the ASCC framework https://www.ontariowoodlot.com/

[3] Nagel et al. 2017. Adaptive Silviculture for Climate Change: A National Experiment in Manager-Scientist Partnerships to Apply an Adaptation Framework. Journal of Forestry 115:167-178. https://academic.oup.com/jof/article/115/3/167/4599814

[4] Petawawa Research Forest (n.d.) Adaptative Silviculture for Climate Change Network. https://www.adaptivesilviculture.org/Petawawa-Research-Forest/project-site

Oakville's Woodland Regeneration Program

Curtis Marcoux, R.P.F., Supervisor- Invasive Species, Parks & Open Space, Town of Oakville

Oakville's Woodland Regeneration Program was originally established as part of a larger response to manage the effects of emerald ash borer, and subsequent ash mortality, in Town-owned woodlands. The Town of Oakville's forestry staff recognized early on that the projected impact the loss of canopy within the woodlands would have and the challenges this would create in achieving the 40% town wide canopy goal for the town. The program was intended to manage the most severely affected areas, facilitate tree regeneration and restore canopy in the face of significant European buckthorn (*Rhamnus carthartica*) pressure.

Based on existing Town inventory, stands or compartments with high ash tree compositions were initially identified. Silvicultural prescriptions were written for the salvage operations and to identify a potential regeneration strategy based on the existing composition and structure of each compartment. Designed to be implemented shortly after salvage logging operations took place, the strategies were categorized as a Prime Site, Enhancement Site, or Natural Regeneration. These were later written as more detailed and stand specific Regeneration Prescriptions, given to a contractor to implement.

The Prime Site designation was for areas where ash mortality and salvage operations mimicked a clearcut. The first step was to treat the European buckthorn in the compartment that had established under the ash canopy, either standing or cut stump application with Garlon RTU (triclopyr oil). Using a mix of trees and shrubs native to the Carolinian region, with selection based on the site's topography and moisture availability, the second step was to replant with a mix of sizes from seedling to small caliper trees at a density of 2300 stems/ha. This tree stocking was used to ensure canopy closure at a very early age, adding to the stand's resilience from potential recolonization efforts of European buckthorn. Town staff accept that thinning would have to occur earlier than typical replanting projects. The total number of native trees and shrubs planted per year is shown in Figure 1.

Map of all Regeneration Sites – Prime sites in orange, Enhancement sites in yellow and Natural Regeneration sites in green.

Enhancement sites were more variable in the approach due to the distribution of ash and existing conditions. They were often comprised of sites that had enough local seed trees to facilitate future regeneration, though low populations of existing regeneration and high woody invasive pressure. This required an active intervention to treat and reduce the invasive pressure of buckthorn and supplement some planted stock. Planting density was adjusted and offset by the higher residual canopy cover on the site.

Where the ash mortality in the compartment was minor or competing woody invasives were scarce and there was enough regeneration or local seed trees to be relied upon to regenerate effectively, the sites were labelled at Natural Regeneration.

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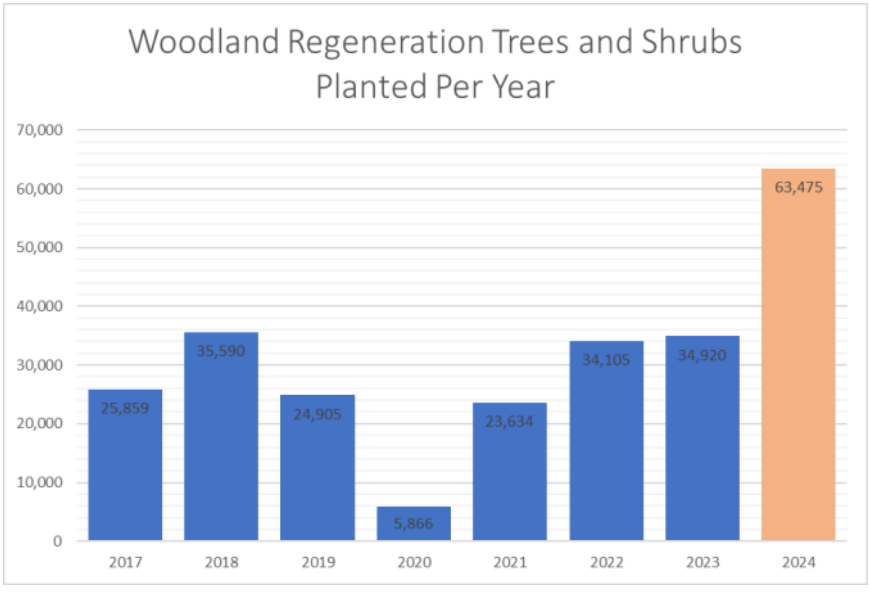

Figure 1. Number of native trees and shrubs planted per year. 2024 has been contracted out and is in progress.

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The program had always relied on excess funding, after the salvage and hazard abatement operations were contracted out. As scheduled work moved into woodlands that had less ash composition, the funding which could be dedicated to regeneration activities was able to increase. The goal was always to shorten the length of time between logging and the subsequent regeneration planting; further reducing the potential establishment of invasives. Average costing on a per hectare basis is included in Figure 2.

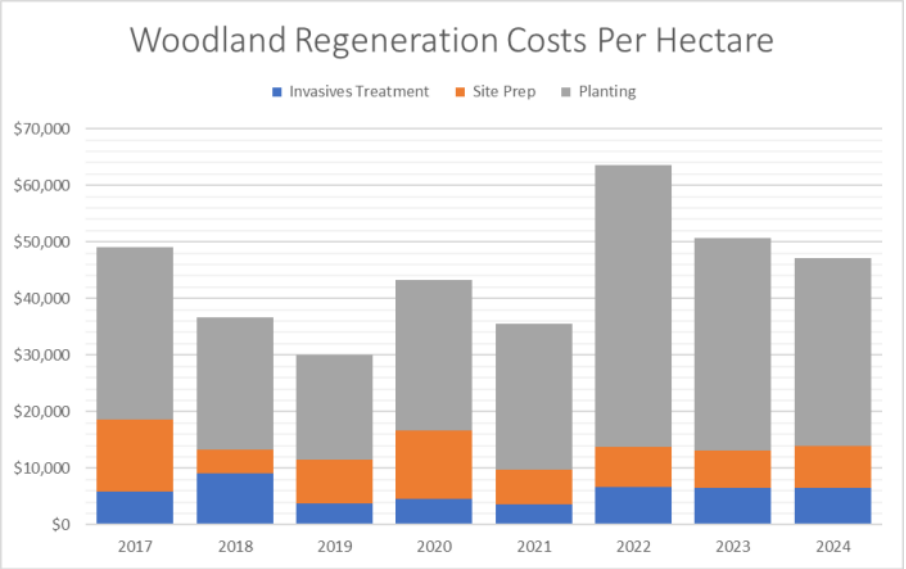

Figure 2. Average costing per hectare for treatment, site prep and planting to help inform future budget forecasts.

Legacy sites are monitored annually in late summer into fall, and mortality assessments are completed to ensure they reach free to grow status. Through the surveys of past sites, additional work is easily prescribed into the scope of the following spring/summer contract. It is expected that sites are monitored and follow up work completed for roughly five years.

The overall success of the program has been great, even in face of the persistent pressures of buckthorn. Anecdotally, we have seen the best growth on rich flood plains, with fast establishment of species like silver maple and sycamore reaching closed canopy quickly and reducing the ability for buckthorn to recolonize the area. These areas often only need an extra one to two rounds of buckthorn treatments to achieve free to grow status. Our toughest challenges are sites that have become woodlands post development, which had really compacted clay soils with little organic matter to support tree establishment. We have found some additional top up planting is needed, along with more continuous maintenance to ensure they are not taken over by weed competition.

Initial Prime site replanting located at Glen Abby Woods after ash salvage.

Although the program was focused primarily on stands with 50% or more ash in the beginning, as salvage logging operations have ceased, it has become a mechanism to attend to stands that are solely comprised of buckthorn or other invasives that are encroaching heavily into our woodlands. This program has also become a vehicle to which other Town of Oakville departments can use to replant necessary compensation for infrastructure projects.

An existing interactive map of all Woodland Regeneration sites can be found on the Oakville Website, allowing the public and others to review and find out the location of any operations.

Urban forestry in Quebec City: Collaborative initiatives by a Research Chair

Claudelle Bourque, MScF, ing. f., **Janani Sivarajah**, PhD, R.P.F., Département des sciences du bois et de la forêt, Faculté de foresterie, de géographie et de géomatique, Université Laval.

Janani Sivarajah, is an RPF in Ontario. She was recently appointed to Université Laval. This article co-authored with Claudelle Bourque who is an ing. f. in Quebec describes how municipal governments and their residents can play a role in developing human resources and educational infrastructure to serve the community's social and environmental goals.

Current state of urban forestry in Quebec city

In Quebec city, the urban forest stands as an important contributor to the city's sustainability and climate mitigation goals, boasting an inventory of more than 115,000 municipal trees, documented and accessible to the public (https://quebio.ca/fr/arbresqc). Embracing a forward thinking approach, the city has adopted the strategic urban forest plan outlined in the Tree Vision 2015-2025. The main objective of this strategic vision is to recognize the value of trees in urban environments, emphasizing their seamless integration of trees into all facets of municipal planning and design. Similarly to other municipalities in Canada, the canopy index was chosen as a key metric to measure the extent of its urban forest, and it was calculated using the city's six boroughs and 35 neighborhoods. Despite, the city's ambitious targets to increase the canopy index from 32% to 35% by 2025, recent assessments reveal a troubling setback, with the current index stagnating at 31% (Table 1). This 1% loss of canopy signals a pressing need for action, with factors such as urban development, large-scale infrastructure projects (e.g., tramway in Quebec city), and emerald ash borer infestations among many other infestations according to the city's mid-term report.

Table 1. Variation in the canopy index for Quebec City (table adapted from mid-term report, Quebec City, 2020)

City	Canopy index in the urban perimeter 2015	Canopy index in the urban perimeter 2020	Variation of the canopy index in the urban perimeter
Quebec city	32%	31%	-1%

Creation of the CRAUM

In response to the 1% decline in canopy index, the City of Quebec has taken a decisive action in 2020, establishing a Research Chair aimed at introducing innovative approaches to better integrate trees and all of its components (e.g., branches, stem, roots) in urban forestry practice with a financial contribution of 2M over five years. Collaborative research chairs between universities and municipalities are widespread in the Province of Quebec. Recognizing the importance of advancing knowledge and practices in urban forestry, Université Laval seized the opportunity to adopt a new direction in this field of research, teaching, and the training of professional urban foresters/forest engineers in Quebec.

The Research Chair on Urban Trees' and its Environment (CRAUM) is committed to aligning its research projects with the city's vision and the needs of its residents.

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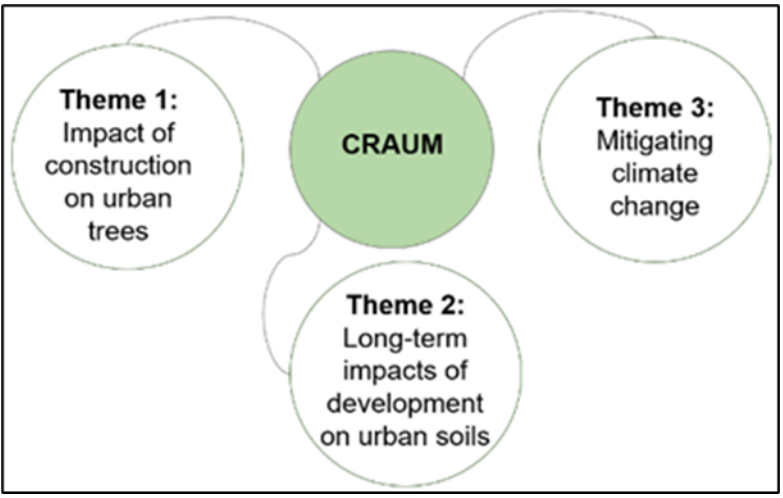

Research themes of the CRAUM identified through a prioritization activity with the City of Quebec staff members.

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Through a prioritization exercise involving the city staff members, CRAUM has identified specific research axes to focus on over the next five years. This strategic approach has highlighted certain knowledge gaps that exist within the practice of urban forestry, prompting CRAUM to distinguish itself from other research chairs in the Province of Quebec, with a particular interest in underground infrastructure (e.g, roots), and urban soils. Our current and future research projects will actively advance these themes, contributing significantly to knowledge and the development of innovative tools for sustainable urban forest management.

Research projects

Since its creation, the CRAUM has continued to expand, with numerous research projects that prioritize science communication and raising awareness among residents, which is central to the Chair's work. The CRAUM revolves around the three main themes highlighted above, with a particular emphasis on understanding the impact of construction activities on urban trees. In urban areas, the cutting of tree roots during infrastructure redevelopment or repair work is a common practice, and often inevitable. This practice can impact the tree's stability, disrupt their ecophysiological functions, and alter the initial state of both soil and trees' surroundings. To address these issues, and co-develop knowledge with the City of Quebec, CRAUM initiated the implementation of a long-term experimental design in 6 parks, where we aim to evaluate the impact of different approaches to protecting mature trees during the establishment of major infrastructure with the ultimate goal of promoting an integrated approach to protection amidst the implementation of gray infrastructures (e.g. roads, cycle paths, buildings).

Root cutting to mimic construction activities on one of the CRAUM's research sites.

One of the 9 trees pits designs for Maguire Project. Credit: ©Quebec City. More pictures of the Maguire Project here.

As we're well aware, human anthropogenic activities tend to have direct consequences not only on trees but also on the underground processes, such as soil health and microbiota. Recognizing the pressing need to tackle these challenges, our second research theme focuses on understanding the long-term effects on tree health and urban soils. The Maguire Project was conceived with this precise objective in mind, it represents a groundbreaking initiative aimed at enhancing urban tree cover through innovative tree pit designs. This living laboratory street, a first of its kind in Canada, serves as a testing ground for nine distinct tree pit designs on 94 trees, all geared toward optimizing tree health. The project is a collaborative effort involving civil engineering practitioners, urban forestry staff, and academics in CRAUM. By prioritizing adequate space for tree growth and emphasizing root development, this project aims to revolutionize tree planting practices in urban areas.

Furthermore, the CRAUM's waste reutilizing project, conducted in collaboration with civil engineering experts, represents another pioneering endeavour aimed at sustainable urban development. This initiative aims to analyze the potential, develop and create constructed "technosol" soils in urban areas by utilizing recycled materials. The primary objective is to increase carbon storage in the soil and mitigate greenhouse gas emissions, while accounting for the principles of the circular economy. The project is also related to the third research theme, focusing on innovative climate change mitigation strategies.

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The Maguire Avenue redevelopment project promotes the greening of modern urban development .
Credit: ©Quebec City.

Urban soil analysis in the lab.

Preparing for CO2 efflux measurements.

Towards the future...

Through the implementation of these innovative projects, CRAUM is spearheading research aimed at identifying effective measures and methods to contribute to the protection of trees during urban development activities. These studies not only seek to enhance our understanding of interactions between tree roots and soil, but also shed light on the societal benefits provided by the urban forests, and their role in achieving climate change objectives. With the Chair's renewal on the horizon in two years, we anticipate opportunities to perform collaborative research with prospective partners. Interested parties are encouraged to reach out to us at sivajanani.sivarajah@sbf.ulaval.ca to explore potential collaborations and contribute to the advancement of urban forestry research! Stay updated by follow

Hemlock woolly adelgid in Ontario

Chris J.K. MacQuarrie, Research scientist, Natural Resources Canada, Canadian Forest Service and **Jim Saunders**, Senior Policy Advisor, Crown Forests and Lands Policy Branch, Ministry of Natural Resources and Forestry

The hemlock woolly adelgid arrived in Ontario in 2012 and now threatens the health of the province's hemlock forests. Invasive pests present a challenge to land managers in that, often, there are no products registered to manage them. Such was the case for hemlock woolly adelgid until recently but now progress has been made in registering five insecticides for the management of hemlock woolly adelgid in Ontario. Three products have full registration, and two products are available through Emergency Registrations.

Registration of insecticides in Canada

Insecticide products with full Canadian registration are available for sale and use if the registration status is maintained by the registrant. Products under emergency registration are available for one year. Emergencies are generally deemed to exist when an unexpected and unmanageable pest outbreak or pest situation occurs that can cause significant health, environmental or economic problems, and registered pesticides and cultural control methods or practices are insufficient to address the pest outbreak.

Emergency Registrations are sponsored by a provincial ministry or federal agency that supports the management of the emergency pest problem. The sponsor submits an application for Emergency Registration of a product to the Pest Management Regulatory Agency (PMRA), a division of Health Canada. This application includes a description of the emergency situation, a rationale for emergency use, a description of the proposed product, registered alternatives and cultural control methods, and letters of support or no-objection. The submission will also contain an explanation for the choice of product, its proposed use pattern, and a description of the socio-economic impact of not obtaining an Emergency Registration. The PMRA reviews the application and makes a determination if an Emergency Registration is needed to address the pest problem. If granted, an Emergency Registration is valid for one year. Emergency registrations are intended to be a temporary measure, and so where a pest infestation is predicted to remain an ongoing issue the product's Registrant is expected to pursue full registration through normal regulatory processes.

Products for the management of hemlock woolly adelgid in Ontario.

In Ontario, prior to 2023, there were two products available for use against hemlock woolly adelgid: IMA-jet and TreeAzin Systemic Insecticide. In 2023, following joint sponsorship by the provinces of Ontario and Nova Scotia, the PMRA approved an additional full registration and two Emergency Registrations. All products registered for use in Ontario are systemic insecticides that are applied to the tree and are then absorbed into the tree's water and nutrient transport system. The insecticides are carried to the twigs where they are ingested by the hemlock woolly adelgid. All products registered for use in Canada can be used in nurseries, exterior plantscapes, woodlots, urban areas and in private, municipal, provincial, and national forested areas.

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Basal bark application of insecticide to hemlock in Nova Scotia. Photo credits, top two photos: Donna Crossland, bottom photo: Scott Robinson, Arborcom Technologies Ltd. Nova Scotia, info@arborcom.ca

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Most of these products and active ingredients have been used for control of hemlock woolly adelgid in the United States for many years and have shown to be effective in limiting damage by the pest. Before selecting a product for use, landowners and land managers should become familiar with their efficacy, target and non-target effects, and local and provincial rules around the use of insecticides. If unsure, consult a professional. All pest control products must be applied by a licensed applicator, following the label and manufacturer's instructions.

The following table describes the five products currently registered for use against hemlock woolly adelgid and provides details for contacting company representatives with expertise in applying these products. A later article will discuss the environmental fate of these products.

Table 1. Products currently registered for use in Ontario against hemlock woolly adelgid.

Product	Active Ingredient	Registration		Application method	Contact
		Status	Number		
IMA-jet	Imidacloprid 5%	Full	31375	Microinjectable systemic insecticide for use with the Arborjet Injection System	Rob Gorden, Director of Urban Forestry, Arborjet, Inc. RobGorden@arborjet.com
IMA-jet 10	Imidacloprid 10%	Full	31479		
TreeAzin Systemic Insecticide	Azadirachtin 5%	Full	30559	Tree injection using the EcoJect® System	Elsa Cousineau, Technical Sales Representative, Lallemand Plant Care ecousineau@lallemand.com
Starkle 20 SG	Dinotefuran 20%	Emergency until October 12, 2024	34653	Basal bark spray	Michael Cunningham, National Forestry Business and Account Manager, Belchim Crop Protection Canada forestryinfocanada@belchim.com
Xytect 2F	Imidacloprid 233 g/L	Emergency until August 23, 2024	34596	Basal bark spray	David Anderson, Product Development & Regulatory Affairs, Rainbow Ecoscience DAnderson@rainbowecoscience.com

For more information on the procedure for registering pesticides or amending registrations for emergency control of pest infestations see:

Heath Canada's Regulatory Directive DIR2017-03: https://www.canada.ca/content/dam/hc-sc/documents/services/consumer-product-safety/reports-publications/pesticides-pest-management/policies-guidelines/regulatory-directive/2017/dir2017-03-eng.pdf

Product label information for each insecticide can be found by searching for the registration number at: https://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php

Mention of specific products in this document does not imply endorsement by the authors or their employers

Machine learning in resource inventories

Craig Robinson, R.P.F., Forsite Consultants Ltd

Canadian forests are very large. In Ontario, our Crown tenured forest management units are typically around 1 million hectares, and this has historically led us to plan for forest management activities using coarse inventories produced using manual photo interpretation processes. We have spent considerable resources and time to create these forest inventories since they are the backbone of our forest management planning processes, and yet, these inventories are widely regarded as only moderately accurate. These inventories are subject to the variability of human interpretation and have evolved little over the last several decades in Canada. They are also limited by time and budget since the time it takes for a photo interpreter to delineate forest stands and estimate attributes is linear in nature. For instance, it takes 10 times as long to inventory 10 times the area. Depending on the budget available to spend on inventory, interpreters could only ever complete as much as time and budget allowed for. Thus, historical inventories were extensive, and detail is limited to what you can describe within about a 10-hectare polygon or stand.

We are now experiencing a revolution in our natural resource inventories. With advances in LiDAR technology, it is now economical to collect large quantities of very detailed and consistent data over our forests. LiDAR is significantly more detailed relative to previous imagery-based data, allowing for large computing and data science methods to be used to predict inventory attributes such as height, volume, species, etc. This permits inventories that are more detailed, rapidly created, and consistent or objective. The use of machine-learning tools now leads to more detailed and accurate forest inventory information.

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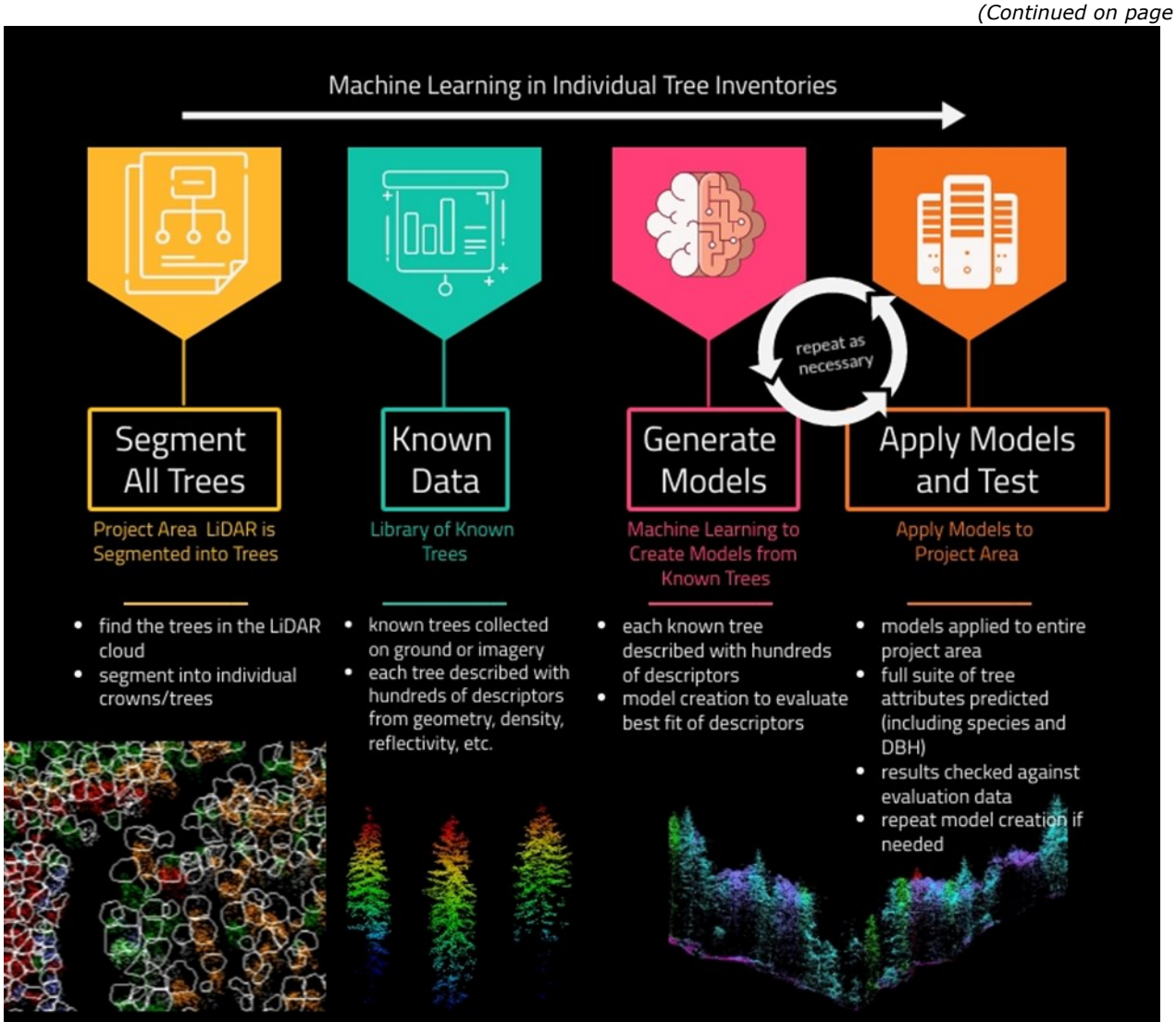

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Machine-learning is primarily about predicting the attributes of unknown objects, based on statistical models developed from known objects or training data. These methods are used to create complex models that use many predictor variables selected from 100's to 1000's of variables that describe a set of training data. The model is then applied to the unknown data to create estimates for the entire population. Using these techniques in an Individual Tree Inventory, we accomplish this by building a large library of trees with known attributes and species (training data). These training trees are collected by humans, and can come from ground measurements, or from stereo image interpretation. The key is to precisely locate each known tree within the LiDAR point cloud and assign it a set of known attributes. These trees are then described using machine-learning mathematical "descriptors" that characterize each known tree's point cloud structure and spectral signature - broadly based on geometry, density, and reflectivity.

Processing then assesses the number and the type of descriptors used to predict species in the model and to maximize species accuracy based on the given properties of the LiDAR and other spectral inputs. Through careful selection of modeling parameters and vetting of sample inputs, human analysts calibrate and tune these computational machine learning models.

Once the species prediction model is completed, and the entire LiDAR dataset has been segmented into individual trees with descriptor variables assigned, the next step is to run the model to predict tree species on all trees in the forest. This can be done on very large areas (millions of hectares) in short timeframes (weeks). To maximize accuracy, the overall results for the project area are validated against control data which can include ground samples, image samples and stem-mapped plots. If the model results require improvement, then the process is repeated until the results meet specifications. The figure on the previous page is a graphical representation of the same process.

The level of detail that is now possible in our inventories has completely changed what is possible for forest planning. Our previous extensive inventories would have described a typical one million hectare forest in about 100,000, ten-hectare polygons. That project may have taken 2 years to complete, and once complete, would be impossible to repeat in a timely manner. With the level of detail available now from LiDAR, and the techniques available to process it, the same one million hectare forest could now be described by about 1 billion individual trees. The project would take about 6 months to complete, and if it needed to be repeated, it might be a just a matter of adjustments and reprocessing.

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DRONE PHOTOGRAMMETRY

HARNESSING THE ADVANTAGES OF DRONE PHOTOGRAMMETRY FOR PRIVATELY OWNED FORESTS

By Ben Gwilliam, R.P.F. in Training, OWA Private Lands Forest Inventory Analyst, York-Durham Chapter

Mapping our forest resources from a high vantage point has been an essential part of forestry in Canada since 1885 when Captain Édouard-Gaston Deville, Surveyor General of Canada, was the fi to map our country using photographs taken from mountain tops. Since then, the advent of airplanes, high-resolution cameras, and now *unmanned aerial vehicles* (UAVs or drones), has delivered unprecedented possibilities in determining both the current state and the rate of change of our forest resources. Particularly, the use of drones in aerial photography and photogrammetry has made it more accessible than ever for landowners to produce the high-resolution forest inventory and monitoring that was once only available to well-resourced industry on Crown land. As part of our ongoing Private Lands Forest Inventory Project, the Ontario Woodlot Association (OWA) has acquired two such drones that are equipped to deliver industry-standard inventory and mapping products from aerial photography and photogrammetry for private land. In this article, we will discuss how they work and how they will bring value to forest owners and managers.

Photogrammetry is the science of taking precise measurements of real-world objects using photographs, like those from a regular camera. It involves taking multiple, overlapping photos from diff positions and angles, and using a common point between these photos and the relative positions of the cameras, to determine the three-dimensional structure of an object. This is much in the same way that our eyes use stereo vision to determine information in our world such as distances. Indeed, this concept is not new and was perfected 140 years ago by the aforementioned Captain Deville when surveying the challenging terrain of the Canadian Rockies, and determining the distances between the peaks. Now, photogrammetry is a standard of map-making and surveying across all industries. It is being used to create things such as the three-dimensional buildings you see on Google Maps, measure the volumes of fill for construction projects, or by reversing the process to create two-dimensional maps from aerial photography with all perspectives removed for measuring areas and distance with centimetre-grade accuracy.

In forestry, aerial photogrammetry is used to produce cost-effective full-coverage maps of key inventory variables such as tree heights, density, and stem counts. Rather than conducting ground surveys where multiple plots are established and measured by hand to estimate these attributes over an entire area, photogrammetry will provide reliable measurements without the need for estimation or inference. Additionally, photogrammetry can produce a point cloud, and much like how a LiDAR point cloud can measure more complex attributes such as basal areas and volumes, these attributes can also be derived from a photogrammetric point cloud. The main limitation here is that photogrammetry, unlike LiDAR, cannot penetrate the tree canopy, so information about the underlying topography must have already been measured during leaf-off conditions, or from vintage LiDAR taken many years prior, regardless of the change in forest condition. However, the relatively low cost of aerial photogrammetry when compared to LiDAR means that inventory data can be acquired annually, or perhaps more frequently, to monitor changes in forest status from pests, wildfires, and harvesting.

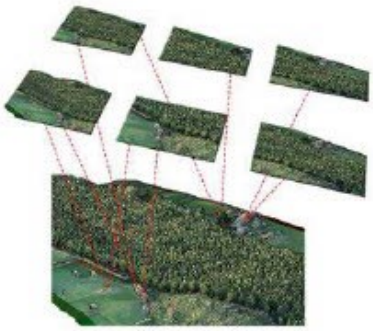
Photogrammetry is not only limited to a top-down perspective, and is in-fact currently being used by autonomous forestry vehicles to navigate complex forested environments and by forestry professionals to create detailed measurements of individual trees such as diameter-at-breast height, precise volumes, location, and taper, or the change in diameter over the full height of the tree. Consumer-grade cameras are all that are needed to be used atop autonomous vehicles, or in the hands of people to provide a cheap, fast, and accurate way to map or measure the surroundings. And like aerial photogrammetry, all three-dimensional processing is done with user-friendly software algorithms that automatically detect the areas within overlapping photos and the relative position of the camera to produce the safest path forward for a harvesting vehicle, or the highly detailed individual tree measurements for the forestry professional.

With the recent acquisition of two photogrammetry drones by the OWA, we plan to fully utilize their capabilities to produce forest inventory products for the public and our members on private lands. As part of our Private Lands Forest Inventory Project, the drones will be used to re-capture point cloud information where vintage LiDAR exists, and due to the changes in forest conditions over time, that LiDAR data no longer refl the current state of the forest. For this reason, it is important to use data that was captured within five-years of the inventory; and while a large portion of the

province has been captured with LiDAR, much of it falls outside this timeline. The OWA can now use its drones to capture an updated photogrammetric point cloud of the tree canopy with the previously acquired LiDAR terrain information (due to its ability to penetrate the canopy), and produce the most up-to-date inventory attributes such as height, volume, and basal area. On a smaller scale, these drones can be used to assist members and forestry professionals to produce high resolution survey-grade maps with centimetre precision for the purposes of Managed Forest Tax Incentive Program (MFTIP) plans, and other inventories and 3D point clouds of woodlots. Repeated measurements will allow for the monitoring of changes, whether it be defoliation by Hemlock Woolly Adelgid or other pests, storage of carbon, or the increased growth over time from thinning prescriptions for our members plantations.

In any case, the OWA has embraced the technology that is leading the forest industry on Crown land into the 21st century and providing value for our members and the public at large. Photogrammetry will provide us with a cost-effective and accessible solution for producing forest inventory on private land and monitoring the changes in forest health for both income-generating forestry and for conservation and wildlife habitat. We are looking forward to developing our capabilities with this and other technologies, and finding ways that we can bring value to our members, and further the goal of sustainable forest management for healthy and productive forests on private land.

Tree measurements can be derived from photographs by taking multiple overlapping images of the same points. Here, the position of the red, purple, and blue points on the tree are captured from two different camera positions and their relative distances from each angle can be calculated. Thus, the entire height of the tree, the diameter and taper of the stem, and even the angles of the branching can be extrapolated from these three points.



The same principle applies to aerial photogrammetry where six overlapping images taken by drone all capture similar points on the landscape. From this, the change in relative distances and heights based on the changing perspective of the drone imagery from different angles give us the precise size of objects on the ground, in this case the volumes and heights within a forested woodlot.

Here, an orthographic image is shown where all perspective has been removed, giving us a perfect top-down view of a recently harvested stand. Using this perspective, we can automatically detect and measure tree crowns (in yellow) providing data on the number and size of the remaining trees. This can be particularly beneficial when done with before/after imagery of storm damage and other disturbances.

Strengthening communications skills of the forest sector through the North American Forest Communicators Network

Ritikaa Gupta, R.P.F.

Forests and forestry are making headlines and are increasingly being acknowledged within international environmental agendas and high-level policy forums. With a changing climate and an increase in wildfires, there is expected to be more attention on forests and how they are managed. In today's context, everyone from citizens to youth and from politicians to tourists, want to know what is happening in local, national and global forests[1]. From management, operations, to local and national planning and international policy initiatives, there is increasing interest in every aspect of a forester's work[1].

CONAFOR Office in Zapopan, Mexico.

Recognizing that the future of forests depends not only on the actions of foresters, but also on public perception and expectations, means that effective communication about forestry and sustainable forest management is critical. The outlook of forestry depends on how informed the public and politicians are of how forests are sustainably managed, used and restored by foresters[1].

In light of the critical role communications increasingly play in shaping the dialogue around forests, the newly formed North American Forest Communicators Network (NA-FCN) holds immense promise. As an attendee at the inaugural workshop in January, representing the Ontario Professional Foresters Association (OPFA), I am confident that NA-FCN will cultivate effective dialogue both within and beyond the forestry sector.

The Forest Communicators Network (FCN) provides a forum for international interaction and cooperation in forest-related communication[2]. The FCN is an initiative of the Food and Agriculture Organization (FAO) of the United Nations. It aims to enhance awareness and understanding of forestry issues to strengthen sustainable forest management in policy and practice[2]. The FCN has regional networks in Africa, Europe & Central Asia, Asia-Pacific, Mediterranean and the Near East and Latin American & the Caribbean.

Ritikaa Gupta presenting at NA-FCN workshop.

The inaugural workshop of the NA-FCN took place at the beautiful and green headquarters of the National Forestry Commission of Mexico (CONAFOR) in Zapopan, Mexico from January 23 to 25 2024. During this three-day workshop, I joined Mexican, American and Canadian forestry professionals to deliberate on the intersection of forestry and communications. Discussions centered around the challenges of communicating various aspects of forestry and sustainable forest management. Additionally, we explored potential collaborative topics, identifying sustainable wood management and wildfire prevention and mitigation as key areas for a coordinated communications campaign.

I also had the privilege of presenting about the OPFA's forest communication initiatives and during my presentation, I emphasized the need to raise awareness of sustainable forest management and the roles and responsibilities of foresters among youth.

(Continued on page 17)

[1] Policy Brief: Criteria and Indicators for Forestry-Related Communication https://unece.org/forestry-timber/documents/2021/04/reports/policy-brief-criteria-and-indicators-forest-related
[2] Regional Forest Communicators Networks https://www.fao.org/forestry/communicators-networks/en/

(Continued from page 16)

Most importantly, I highlighted that forestry deserves greater recognition as a professional discipline, akin to fields such as medicine, engineering, and law.

Growing up, forestry was not on my list of career options and in my experience, within the Canadian forest sector, I've noticed there simply aren't enough youth working nor interested in the forest sector. As a young forester, and one of the few youth members of NA-FCN I aspire to leverage the FCN to raise awareness of the path of forestry among youth across North America.

Students with Ritikaa Gupta (in center) from CECFOR 01.Left to right: Emanuel Lagunas Lucho, Ángel Omar Mora Urbano, Odalis Yosemeli Rincón Jerónimo, Amelia Rodriguez Huerta.

I was pleasantly surprised to see four young students from Centro de Educación y Capacitación Forestal (forest education and training centers (CECFOR)) located in Uruapan, Michoacan. CECFORs' are specialized high schools that offer forestry focused subjects. They are an educational model aimed to empower rural youth, equipping them with skills and knowledge to enable them to meaningfully contribute to their communities. The students' genuine passion for forestry was evident as they actively participated in the workshop.

On the second day, we participated in a training session titled 'Using Generative Artificial Intelligence for Communication Activities' led by Dante Licona, an experienced social media strategist and international communications consultant. Artificial Intelligence (A.I.) is a new technological tool already utilized in the forest sector for tasks like fire prediction, initial inventories, and data analysis related to soil and growth. During the training session, I learned to leverage A.I. for forestry communications, including creating specific messaging, generating ideas, producing images, and even synthesizing audio. While A.I. has immense potential to advance awareness of sustainable forest management, it comes with certain downsides we must be cautious of such as the accuracy of information generated.

Away from the coast and city, on day three we traveled to the State of Colima in Western Mexico. It is home to the Colima Volcano which rests in between the mountain range of Cordillera Costera del Sur. The Colima Valley was a unique landscape with steep cliffs and acres of cultivated aloe, agave, corn stretched across the valley.

The itinerary included a visit to Laguna La Maria, a volcanic caldera inhabited by a local community that grows and produces medicinal forest plants with the guidance of traditional ecological knowledge. They also practice ecotourism with support from CONAFOR for capacity building. Witnessing community women come together to show us their cultivated plants and their medicinal benefits was humbling. Their willingness to share and invite us into their home gardens allowed us to see firsthand the power of traditional knowledge. We also had the chance to sip locally grown coffee while meeting a local farmer who shared the uniqueness of Colima's coffee beans grown in volcanic soil. The community visit was inspiring and demonstrated the power and depth of traditional knowledge and their kind willingness to share this with others.

Woman farmer sharing traditional knowledge of plants in Colima.

(Continued on page 18)

(Continued from page 17)

Forest engineer, Luis David Aceves Rangel and Registered Professional Forester, Ritikaa Gupta.

During this field visit, I also had the opportunity to interact with forest engineer, Luis David Aceves Rangel who left a lasting impression in terms of his forestry knowledge and experience. As the state manager of CONAFOR's Colima office, his work extends beyond paperwork as he's on the ground, leading and organizing attacks on wildfires in the region. In addition to his firefighting work, Luis collaborates closely with the local community, to advance sustainable forestry practices while safeguarding community livelihoods.

As we conversed, I learned forest management requires a different approach as in Mexico, lands are under the ownership of rural communities who practice a communal approach to forest management (ejidos). This influences how forests and fires are managed. Luis emphasized the importance of fostering harmony between people and forests requires listening, cultural sensitivity, trust and a deep understanding of local dynamics.

With climate change and an increase in the number and intensity of forest fires, communication with citizens and forest communities close to forested areas is more critical than ever. My experience made me realize the importance of collaboration to safeguard our forests and promote ecological balance. I look forward to supporting the NA-FCN in effectively communicating within and beyond the forestry sector about sustainable forest management, the multiple benefits and uses of forests and various forest issues.

Laguna La Maria, Comala, Colima.

Between workshop sessions, I explored Guadalajara, a beautiful city where modern and historical architecture blend to make for a vibrant city. The cuisine is full of flavor and the people are kind. People love Mexico for its beaches but I fell in love with Mexico's people, culture and unique green landscapes.

Guadalajara museum at night.

Sault Ste. Marie stops during the Annual Conference's field tour

Lucie Harvey, R.P.F. and **John Harvey**, R.P.F.

In advance of April's Ontario Professional Foresters Association (OPFA) Annual Conference and Annual General Meeting (Conference and AGM) in Sault Ste. Marie, the OPFA editorial board felt it may be of interest to showcase Sault Ste. Marie (and surrounding area) and its unique role in forestry. The following is the second of two articles (first article appeared in December edition) showcasing Sault Ste. Marie, specifically the stops during the Annual Conference's field tour component scheduled for April 16th:

Aside from the fascinating agenda and guest speakers assembled by the OPFA Annual Conference and AGM organizing committee, attendees at this April's Conference and AGM are also being provided the timely opportunity, all within the Great Lakes-St. Lawrence Forest Region of Ontario, to visit some of the Sault Ste. Marie and surrounding areas' most innovative forestry sites. This year's field tour is comprised of three stops, including:

Black Bird Management Ltd. – about 35 minutes north of Sault Ste. Marie, at Harmony Bay, just off Lake Superior, is the site of a very large maple syrup producing facility and the privately owned woodlot that Black Bird manages. Black Bird is an Ontario based corporation that has been managing Astina Forest AG's (Astina) forestlands since 2016. Astina is a pioneer in applying a selection harvesting system in the region and is well known in the local forest industry and social community for its sound forest management practices. In 2017, Black Bird began researching maple syrup production and selected a site, based on its unique topography, at Harmony Bay. Black Bird began producing maple syrup and is now the largest operation in Ontario. In 2023, Black Bird began implementation of a carbon offset project on Astina's forestlands.[1]

Following the Black Bird tour, the group will head back into town, marveling at the scenery of Lake Superior coastline, and enjoy a traditional Sault Ste. Marie-Italian lunch at Grand Gardens restaurant in the north end of town. From there, the group will divide into two with one going heading to Arauco's Medium Density Fiberboard mill (MDF) and the other visiting the Ontario's Ministry of Natural Resources and Forestry (MNRF) arboretum (both groups will switch mid-afternoon, all attendees will see both the arboretum and MDF facility).

The Arauco mill, located just north of the St. Mary's River between Lake Superior and Lake Huron, was built in 1996. Like many forest product producing facilities, it has changed hands a few times in the last almost 30 years of operations. The Arauco facility is one of only two MDF mills in Ontario (the other being Rosberg's facility in Pembroke), where by-products from other forest product producing facilities are manufactured into MDF. Arauco is a multi-national corporation headquartered in Santiago, Chile. The Sault Ste. Marie facility employs approximately 130 people. [2,3,&4]

A short drive west of Arauco is the Ontario Forest Research Institute (OFRI) arboretum. The arboretum is a fully fenced research enclosure and features several service buildings, infrastructure for irrigation, and 95 hectares of land to support MNRF research. Current research focus includes understanding the effects of climate change and forest management practices on tree growth, interactions among tree species grown in mixtures, and forest genetics.[5]

Once the concurrent Arauco and arboretum tours have concluded, the group will be whisked away in their coach bus and returned to Sault Ste. Marie's landmark Water Tower Inn.

References

[1] https://www.black-bird.ca/about-us

[2] https://www.sootoday.com/local-news/flakeboard-buys-g-p-stake-in-sault-operation-98635

[3] https://www.sootoday.com/local-news/some-good-news-in-the-saults-economy-11-photos-191393

[4] https://files.ontario.ca/mnrf-ontario-forest-industry-at-a-glance-map-en-2023-01-10.pdf

[5] https://www.ontario.ca/page/forest-research

Notice of the Annual General Meeting for the 2023 fiscal year

Notice is hereby given of the Annual General Meeting of Members of the Ontario Professional Foresters Association for the 2023 fiscal year to be held virtually and in-person using hybrid video conference technology at 3:30 p.m.-5:30 p.m. (EDT) Wednesday , April 17, 2024, for the purpose of conducting the affairs of the Association, including:

Agenda Items (may be subject to change):

1. Call to order
    - Notices, Members, and proxies
2. President's remarks
    - Hybrid AGM procedures
    - Who can vote?
    - Accessing the 2023 Annual Report
3. In memoriam
4. Recognition of new Members
5. Approving the minutes of the Annual General Meeting for the 2022 fiscal year
6. Receive Annual Reports
    - Receive and consider reports of the President, Executive Director & Registrar, Auditor, and Committee Chairs for the fiscal year December 1, 2022, to November 30, 2023
7. Auditor's Report and Financial Statements
    - Receive the audited Financial Statements as of November 30, 2023
8. Appointment of Association Auditor
    - Report Council's appointment of the Auditor for the fiscal year ending November 30, 2024
9. Concluding the Annual Report
    - Thank you to the sponsors and exhibitors of the 2024 Annual Conference
10. Confirming and approving the acts and procedures of Officers and Councillors
11. Business highlights in 2023
12. 2025 Annual Conference
    - Location
    - Acknowledging the conference organizing team
13. Termination of the Annual General Meeting

If you are eligible to vote and are unable to attend this meeting, please complete the Instrument of Proxy (below) and return it to the OPFA office.

Fred Pinto, R.P.F., Executive Director and Registrar

INSTRUMENT OF PROXY

I, _____
(Name of Member) (Member number)

of

_____
(address of Member)

Being a Member of the Ontario Professional Foresters Association hereby appoint:

Peter Nitschke, R.P.F., of Stirling, Ontario
WHOM FAILING
Lacey Rose, R.P.F., of Pembroke, Ontario

OR

_____, (_____) of _____
designation

as my proxy to vote on my behalf at the
Annual General Meeting of the Members of the Association
to be held virtually and in person at 3:30 p.m. (EDT) Wednesday, April 17, 2024.

Dated this _____ day of _____, 2024 at _____

_____
(signature of Member)

IF YOU ARE NOT ABLE TO ATTEND THE ANNUAL GENERAL MEETING, PLEASE RETURN THIS PROXY TO THE OPFA OFFICE by 2:00 p.m. (EDT) Friday, April 10, 2024.

Email: opfa@opfa.ca, Mail: PO Box 30038 Georgetown RPO Mountainview, Ontario L7G 6J8

Issue 250 June 2023 Correction: Spatial planning in Ontario – The dawn of a new day

Douglas (Doug) E.B. Reid, R.P.F. in Training, Research Scientist – Boreal Silviculture Program, Centre for Northern Forest Ecosystem Research

The author would like to add a citation to page 16 as follows: Enter the Strategic Forest Management Model (SFMM; Davis 1999), which started as a graduate student project at the University of Toronto (Davis and Martell, 1993)."

Davis, R.G. and Martell, D.L., 1993. A decision support system that links short-term silvicultural operating plans with long-term forest-level strategic plans. Canadian Journal of Forest Research, 23(6), pp.1078-1095.

sml-law.com/resources/grey-areas/

SML's Grey Areas newsletter has been in publication since July 1992 and discusses the latest developments in professional regulation. New issues are published monthly.

Recent articles:

December 2023, Issue No. 285 – Prioritizing Board Time – Part 1

A precious resource for regulators is the time, energy, and attention of their Board of Directors (sometimes called their Council). As the highest-level decision maker within the organization, a Board needs to prioritize its efforts to ensure that the regulator is effective. Board members typically are volunteers (honoraria tend to be modest) who devote only a part of their professional lives to Board business.

January 2024, Issue No. 286 – Prioritizing Board Time – Part 2

In the last issue of Grey Areas, we analyzed the allocation of the attention by Boards of Directors of regulators within four categories: 1. Public Protection 2. Governance 3. Education of the Board, and 4. Board-Level Operations. November 2023, Issue No. 284 – How They Do Things Across the Pond

February 2024 – No. 287 – Uncompassionate Regulation

Regulators are increasingly moving towards "compassionate regulation". These initiatives sometimes follow instances of self-harm by registrants facing complaints, investigation, and discipline.

Member News

New Full (R.P.F.) Members:

Matt Aleksa
Ethan Brandt
Laura Curran
Rainer Kurt Dinkelmann
Tristan Flood
Autumn Lachine
Jordan Swayze

Please welcome and support the following people who have been admitted into the OPFA but are not yet entitled to practice professional forestry in Ontario:

New Provisional Members (R.P.F. in Training):

(may practice if under the direct supervision of a qualified member)

Andrew Base
John Hoogendoorn
Amber James
Parveet Kaur
Kyle Levesque
Valentine Lynch
Krishna Selvakumar
Michael Trouten
Madison Ulitsky

New Provisional Members-R.P.F. in Training with Scope:

(may practise within their prescribed scope of practice)

Adam Buitendyk
Jake Wakelin
Sam Warrington
Felix Winkelaar

New Student Members:

Erica Dixon
Victoria Garcia
Sven Huycke
Emmanuel Kaa
Davan Mulligan
Howard Ouyang
Monique Sewornu
Joseph Tetteh
Qingshan Yin

The following registrants are not entitled to practise professional forestry in Ontario:

New Inactive Member - R.P.F. (Non-Practising):

Kyle Myschowoda

New Non-Resident Member- R.P.F.

Alan Thorne

New Life Members-R.P.F. (Ret.)

Gail Ballak
Herb Bax
Kevin Belanger
Charlotte Caron
Susan Collins Lindquist
Deb MacEwen
Russell Williams

The following people are no longer registrants of the OPFA and are not entitled to practice in Ontario:

Resigned, Associate Members:

Anne Lennox
Earl Dertinger

Resigned, Full Members:

Lauren Quist
Robert Scott
Donald Willis

Resigned, Inactive Member:

Stan Vasiliauskas

Resigned, Provisional Members:

Joy Das
Sylvia Ho
Shraven Patel
Sara Ross
Justin Snape

Continuing Education

Webinars and Other Resources

Websites that offer free webinars to earn CEUs for your membership maintenance.

- Canadian Institute of Forestry (CIF-IFC) - Offers considerable resources and ongoing lecture series
  https://www.cif-ifc.org/e-lectures/
- Ontario Ministry of Natural Resources and Forestry. MNRF Science Insights, contact Kristy Mckay, Science Transfer Specialist at Kristy.McKay@ontario.ca
- Forestry and Natural Resources Webinars
  http://www.forestrywebinars.net/
- Conservation Webinars
  http://www.conservationwebinars.net/
- Urban Forestry Today
  http://www.urbanforestrytoday.org/
- Climate Webinars
  http://www.climatewebinars.net/
- Cornell University
  http://blogs.cornell.edu/cceforestconnect/subscribe/
- Forestry Chronicle
  http://pubs.cif-ifc.org/journal/tfc
- Canadian Journal of Forest Research
  http://www.nrcresearchpress.com/journal/cjfr
- FPInnovations
  https://web.fpinnovations.ca/blog/
  https://wildfire.fpinnovations.ca/index.aspx
- Tree Research and Education Endowment Fund (TREE Fund)
  https://treefund.org/webinars
- Eastern Ontario Model Forest LDD Moth Webinar Link to the recording on YouTube Channel: https://youtu.be/U4BZOM8GtyU
- Ontario Woodlot Association Oak Wilt Webinar Link and passcode to the recording: https://us06web.zoom.us/rec/share/1xAH8qHGgwVV9ki-78A83oQMbcIlZKbH5uHqHtP7xLfEJ8l8mNJE7U4iGx2nZuFp.3LYLtY_SIGeCzRor
  Passcode: 8Mnwb+@J
- Ontario's Centre for Research & Innovation in the Bio-economy (CRIBE) - Forest EDGE. Decision support tools, projects and case studies.
  https://www.nextfor-forestedge.ca/
- Canadian Partnership for Wildland Fire Science (Canada Wildfire). Partnership members include: the Canadian Forest Service, Alberta, BC, Northwest Territories, Saskatchewan and the University of Alberta. Originally focused on western Canada, it has expanded and includes information and research of interest to forest managers elsewhere in Canada.
  https://www.canadawildfire.org/
- Invasive Species Centre webinar series
  https://www.invasivespeciescentre.ca/learn/webinar-series/
- PlaniIt Geo Urban Forestry Webinars
  https://planitgeo.com/urban-forestry-webinars/

Coming Events

2024 OPFA Annual Conference and AGM
April 16 to 18, 2024
Sault Ste Marie, ON
https://opfa.ca/about-us/event-list

Ontario Woodlot Association Annual Meeting, Conference and Tour 2024
April 23 to 24, 2024
Barrie, ON
https://www.ontariowoodlot.com

Please send any upcoming events to opfanewsletter@gmail.com